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Effects of Six Nematicides and Two Fungicides, Applied in Various Treatment Combinations, on Peanuts

ABSTRACT

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In tests of six nematicides and two fungicides applied to peanuts for control of *Meloidogyne arenaria* and *Sclerotium rolfsii*, peanut yields increased significantly when nematicides were applied preplant and postplant. In most cases where preplant treatments gave good nematode control, postplant nematicide treatments did not further increase yield. Yields increased with some combinations of nematicides and fungicides applied preplant and postplant or postplant alone. Yield increases were associated with suppression of nematodes, fungi, or both.
Keywords: *Arachis hypogaea*, fungi, fungicides, fungus control, *Meloidogyne arenaria*, nematicides, nematode control, nematodes, peanuts, pest control, pesticides, *Sclerotium rolfsii*.

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CONTENTS

EFFECTS OF SIX NEMATICIDES AND TWO FUNGICIDES, APPLIED IN VARIOUS COMBINATIONS, ON PEANUTS

By Norman A. Minton, Alex S. Csinos, and Durham K. Bell[1]

INTRODUCTION

Nematodes and Sclerotium rolfsii Sacc. (which causes southern stem rot) are two economically important pathogens of peanuts, Arachis hypogaea L. Losses in the United States caused by nematodes were estimated to be 10% for the 1962-68 period (1). A survey of 331 peanut fields in 17 Georgia peanut-producing counties in 1974 revealed that root-knot nematodes, Meloidogyne spp., were present in 9.7% of the fields; lesion nematodes, Pratylenchus spp., in 16.9%; and ring nematodes, Criconemella ornata (Raski, 1958), in 97% (11). However, in recent years, improved control measures, including the use of nematicides and crop rotations, have reduced losses. For instance, peanut losses caused by nematodes in Georgia in 1981 were estimated at 2% or 15 million kg (22). Losses from southern stem rot in Georgia in 1981 were estimated at 4% or 30 million kg (22). However, 1981 was a dry year, and losses in most years are greater, as in 1976 when the estimated loss was 10% (21). These pathogens may occur separately or together in the same field.

Chemicals have reduced damage to peanuts caused by nematodes (10, 16, 17) and southern stem rot (4, 5, 19). Traditionally, nematicides have been applied only preplant or at planting for nematode control. However, in Oklahoma (6) in soil infested with Pratylenchus brachyurus (Godfrey) Goodey and in Florida (3) in soil infested with Meloidogyne arenaria (Neal) Chitwood, peanut yields were greater in plots treated with nematicides both at planting and at pegging than in those treated only at planting. Also in Oklahoma (20), a nematicide plus the fungicide PCNB increased peanut yields more than the additive increase from either the nematicide or PCNB alone. Later research in Alabama (12, 14) indicated that PCNB and the nematicides fensulfothion and ethoprop reduced the incidence of S. rolfsii in peanuts. In Georgia (21), in soil infested with P. brachyurus and S. rolfsii, PCNB alone increased yields 1 of 3 years, but PCNB plus fensulfothion increased yields each of the 3 years.

The objective of the studies reported here was to evaluate several nematicides applied at planting and postplant and fungicides applied postplant for control of M. arenaria and S. rolfsii occurring together on peanuts. Parts of these studies have been reported earlier (8, 9).

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MATERIALS AND METHODS

Four field experiments were conducted during 1976-80 at Tifton, Ga., on Tifton loamy sand infested with M. arenaria and S. rolfsii. Infestation levels of M. arenaria and S. rolfsii varied from year to year and among experiments within years. The experimental design for experiments 1, 2, and 4 was a split plot and for experiment 3, a split-split plot. Each subplot consisted of two rows 7.6 m long spaced 0.9 m apart.

Six nematicides and two fungicides were evaluated (table 1). Application rates of active ingredient (a.i.) were based on linear meter of row per hectare with 0.9-m row spacings. Methods of application were as follows:

Experiment 1.--Preplant treatments applied 19 days before planting in 1977 and at planting in 1978 consisted of DBCP injected 20 cm deep using two chisels per row spaced 30 cm apart and ethoprop and phenamiphos each applied in a 46-cm wide band and incorporated 10-15 cm deep. Postplant treatments consisted of ethoprop, phenamiphos, PCNB, ethoprop + PCNB, and phenamiphos + PCNB each applied in a 46-cm band over the row before light cultivation 42 and 55 days after planting in 1977 and 1978, respectively.

Experiment 2.--DBCP applied preplant was injected 20 cm deep using two chisels per row 13 cm to either side of the row. Granular PCNB in treatments 1 and 2 and ethoprop in treatments 1 and 3 were each applied in a 46-cm band over the row 49 days after planting, and wettable carboxin was sprayed in a 46-cm band over the row 50 days after planting.

Experiment 3.--Granular phenamiphos, aldicarb, carbofuran, and ethoprop were each applied by three methods: (a) 3.4 kg a.i./ha of nematicide was applied preplant in a 46-cm band and incorporated 10-15 cm deep; (b) 1.7 kg a.i./ha of nematicide was applied preplant in a 46-cm band and incorporated 10-15 cm deep; then 1.7 kg a.i./ha of the same nematicide was applied postplant in a 46-cm band over the row before light cultivation 41 and 56 days after planting in 1977 and 1978, respectively; (c) 1.1 kg a.i./ha of nematicide was applied preplant in a 23-cm band and incorporated 10-15 cm deep, then 2.3 kg a.i./ha of the same nematicide was applied postplant in a 46-cm band over the row before light cultivation 41 and 56 days after planting in 1977 and 1978, respectively. PCNB was applied in a 46-cm band over the row 41 and 56 days after planting in 1977 and 1978, respectively.

Experiment 4.--Preplant treatments were phenamiphos at 1.1 kg a.i./ha applied in the planting furrow, phenamiphos at 2.8 kg a.i./ha applied in a 46-cm band and incorporated 5 to 8 cm deep and ethylene dibromide injected at 7.9 and 35.8 kg a.i./ha 20 cm deep two chisels per row 13 cm to either side of the row. Postplant treatments

Table 1.--Nematicides and fungicides applied to peanuts

Common name	Trade name	Chemical name
		Nematicides
Aldicarb..............	Temik..........	2-Methyl-2-(methylthio)propionaldehyde O-(methylcarbamoyl)oxime.
Carbofuran............	Furadan........	2,3-Dihydro-2,2-dimethyl-7-benzofuranyl methylcarbamate.
DBCP..................	Nemagon........	1,2-Dibromo-3-chloropropane.
Ethoprop..............	Mocap..........	O-Ethyl S,S-dipropyl phosphorodithioate.
Ethylene dibromide....	EDB............	1,2-Dibromoethane.
Phenamiphos...........	Nemacur........	Ethyl 4-(methylthio)-M-tolyl isopropylphos-phoramidate.
		Fungicides
Carboxin..............	Vitavax........	5,6-Dihydro-2-methyl-1,4-oxathiin-3-carboxanilide.
PCNB..................	Terraclor......	Pentachloronitrobenzene.

were phenamiphos at 1.1 and 2.8 kg a.i./ha applied in a 46-cm band over the row 37 and 54 days after planting in 1979 and 1980, respectively, and ethylene dibromide at 17.9 and 35.8 kg a.i./ha injected 20 cm deep two chisels per row 13 cm to either side of the row 42 and 58 days after planting in 1979 and 1980, respectively.

Each year the soil was turned about 25 cm deep with a moldboard plow. 'Florunner' peanut seeds were planted at the rate of 100 kg/ha in late April or early May. Peanuts were harvested 130-140 days after planting. Fertilizer and lime were applied as recommended on the basis of soil tests for peanut production in Georgia. Gypsum (calcium sulfate) was applied at 700 kg/ha each year during the early bloom stage. Weeds were controlled with recommended herbicides and cultivation. Insects and diseases (with the exception of *S. rolfsii*) were controlled according to recommended practices for Georgia.

Soil samples collected from the root zone before harvest were assayed for nematodes using the centrifuge-sugar flotation method (7). Ten plants per plot were rated at harvest for root-knot nematode damage using a scale of 1-5 with 1=no galls, 2=1%-25%, 3=26%-50%, 4=51%-75%, and 5=76%-100% of roots and pods galled. The number of *S. rolfsii* (southern stem rot) infection loci per 15.2 m of row was recorded within 12 hours after digging-inverting. An *S. rolfsii* infection locus is defined as one or more plants infected per 31 cm of row (13). Pods were weighed when the moisture was about 8%, and yields per hectare were calculated. Data were subjected to analysis of variance, Duncan's multiple-range test, correlation, and stepwise regression analysis (18).

RESULTS AND DISCUSSION

Experiment 1

Among preplant treatments, peanut yields were significantly greater in plots that received phenamiphos than in plots that received ethoprop or no treatment (table 2). All postplant treatments, except PCNB, increased yields significantly in plots that did not receive a preplant treatment. Yields from plots with no preplant treatment but treated postplant with phenamiphos + PCNB were greater than those from plots that received only ethoprop, phenamiphos, PCNB, or no treatment. Also, with no preplant treatment, plots treated postplant with ethoprop + PCNB had greater yields than those in plots that received only PCNB or no treatment. None of the postplant treatments applied to plots treated preplant with DBCP or phenamiphos increased yields. Conversely, all postplant treatments, except ethoprop, applied to plots treated preplant with ethoprop increased yields significantly. When phenamiphos was applied preplant, yields were significantly greater with ethoprop + PCNB than with phenamiphos, PCNB, and phenamiphos + PCNB applied postplant. All treatments applied postplant significantly increased average yields, but ethoprop + PCNB and phenamiphos + PCNB were superior to each chemical applied alone.

Larval counts of *M. arenaria*, root-knot indices, and loci of southern stem rot (tables 2,3) suggest that yield increases were associated with suppression of both pathogens by the treatments, although southern stem rot loci were not reduced significantly by any preplant treatment. PCNB applied postplant alone to plots that did not receive preplant treatments reduced southern

Table 2.--Peanut yields and root-knot indices as affected by preplant nematicide treatments and postplant nematicide and fungicide treatments, 2-year average, 1977-78[1] (experiment 1)

Preplant treatment and kg a.i./ha	Postplant treatment and kg a.i./ha: Control	Ethoprop 10G, 3.4	Phenamiphos 15G, 2.8	PCNB 10G, 11.2	Ethoprop 10G, 3.4, + PCNB 10G, 11.2	Phenamiphos 15G, 2.8, + PCNB 10G, 11.2	Average
				Yield (kg/ha)			
Control	4,143Db	4,756BCa	4,891BCa	4,446CDa	5,184ABa	5,484Aa	4,817a
DBCP 12.1EC, 10.1	4,703Aab	4,837Aa	4,871Aa	4,996Aa	5,187Aa	5,246Aa	4,968a
Ethoprop 10G, 3.4	4,238Bb	4,708ABa	4,866Aa	4,904Aa	4,842Aa	5,271Aa	4,805a
Phenamiphos 15G, 2.8	5,078ABa	5,209ABa	4,647Ba	5,032Ba	5,609Aa	4,844Ba	5,070a
Average	4,541A	4,878B	4,819B	4,837B	5,206C	5,211C	....
				Root-knot index			
Control	3.1Aa	2.5Bab	2.3BCa	3.1Aa	2.6ABa	1.9Ca	2.6a
DBCP 12.1EC, 10.1	2.4Ab	2.1A-Cbc	1.7Ca	2.4Ab	2.3ABab	1.8BCa	2.1b
Ethoprop 10G, 3.4	3.3Aa	3.0ABa	1.9Da	2.7BCab	2.8A-Ca	2.3CDa	2.7a
Phenamiphos 15G, 2.8	1.8Ab	1.6Ac	1.7Aa	1.7Ac	1.7Ab	1.7Aa	1.7c
Average	2.6A	2.3B	1.9C	2.5AB	2.3B	1.9C	....

[1] Data followed by the same capital letter in rows or by the same lowercase letter in columns within yield or root-knot index data are not significantly (P=0.05) different according to Duncan's multiple-range test.

Table 3.--Effects of preplant nematicide treatments and postplant nematicide and fungicide treatments applied to peanuts on *Meloidogyne arenaria* larvae in the soil and number of southern stem rot infection loci, 2-year average, 1977-78[1] (experiment 1)

Preplant treatment and kg a.i./ha	Postplant treatment and kg a.i./ha: Control	Ethoprop 10G, 3.4	Phenamiphos 15G, 2.8	PCNB 10G, 11.2	Ethoprop 10G, 3.4, + PCNB 10G, 11.2	Phenamiphos 15G, 2.8, + PCNB 10G, 11.2	Average
	Number of nematode larvae per 150 cm^3 soil						
Control........	178ABa	120ABa	26Ba	293Aa	88Bab	19Bb	121a
DBCP 12.1EC, 10.1.	124Aa	68Aa	24Aa	211Aa	30Ab	52Aab	85a
Ethoprop 10G, 3.4.	343Aa	253ABa	106Ba	232ABa	274ABa	269ABa	246a
Phenamiphos 15G, 2.8.	129Aa	79Aa	91Aa	133Aa	63Aab	67Aab	94a
Average.....	194AB	130A-C	62C	217A	114BC	102BC	....
	Number of loci per 15.2 m of row						
Control........	13.8Aa	8.4Ba	9.3Ba	9.2Ba	5.3Ba	4.8Ba	8.4a
DBCP 12.1 EC, 10.1.	9.4Aa	8.0Aa	11.5Aa	7.3Aa	8.0Aa	7.7Aa	8.7a
Ethoprop 10G, 3.4.	11.4Aa	4.4Ca	10.0ABa	6.5BCa	7.0BCa	4.2Ca	7.3a
Phenamiphos 15G, 2.8.	8.7ABa	6.3BCa	11.3Aa	10.5ABa	3.2Ca	7.7ABa	7.9a
Average.....	10.8A	6.8BC	10.5A	8.4B	5.9C	6.1C	....

[1]Data followed by the same capital letter in rows or by the same lowercase letter in columns within larval or loci data are not significantly (P=0.05) different according to Duncan's multiple-range test.

stem rot loci but had no effect on nematode populations or yields.

Peanut yields were negatively correlated (P=0.01) with root-knot indices (r=-0.47) and southern stem rot loci (r=-0.47). Stepwise regression analysis indicated that 23% of yield variations could be attributed to root-knot nematodes as estimated by root-knot indices and that 24% could be attributed to southern stem rot as estimated by the number of loci.

Experiment 2

Peanut yields from plots treated preplant with DBCP and postplant with carboxin were greater than from plots treated postplant with carboxin (table 4). Also, the average yield in DBCP-treated plots was greater than in nontreated plots. PCNB + ethoprop applied postplant increased yields in both DBCP-treated and non-treated plots. DBCP reduced root-knot indices and the number of *M. arenaria* larvae in all treated plots (table 4). Fungicide and fungicide-nematicide treatments applied postplant did not affect root-knot indices and population levels of *M. arenaria*. The number of southern stem rot infection loci in plots that received preplant DBCP as well as those that did not was reduced by postplant PCNB + ethoprop; also, the numbers in plots treated preplant with DBCP was reduced by postplant carboxin + ethoprop (table 4). However, neither PCNB nor carboxin without ethoprop reduced southern stem rot loci in the presence or absence of DBCP. DBCP had no effect on southern stem rot. Large yield differences were required for statistical significance because of the great variability (correlation coefficient=18.3%) caused by severe nematode and southern stem rot infections. Yields were negatively correlated (P=0.01) with root-knot indices (r=-0.51) and southern stem rot loci (r=-0.70). Stepwise regression analysis indicated that 49% of yield variation could be attributed to root-knot nematodes as estimated by root-knot indices and that 25% could be attributed to southern stem rot as estimated by the number of loci.

Table 4.--Effects of nematicide-fungicide combinations on peanut yields and *Meloidogyne arenaria* and southern stem rot control, 1976[1] (experiment 2)

Preplant treatments and kg a.i./ha	Postplant treatments and kg a.i./ha					
	Control	PCNB + ethoprop 10 + 3G, 11.2 + 3.4	PCNB 10G, 11.2	Carboxin 75WP, 1.2 + ethoprop 10G, 3.4	Carboxin 75WP, 1.2	Average
	Yield (kg/ha)					
Control	2,651Ba	4,325Aa	3,667ABa	3,358ABa	2,903Bb	3,381b
DBCP 12.1 EC, 10.1	3,642Ba	5,196Aa	4,635ABa	4,358ABa	3,944ABa	4,355a
	Root-knot index					
Control	4.4Aa	3.3Aa	4.2Aa	3.3Aa	3.7Aa	3.8a
DBCP 12.1 EC, 10.1	2.8Ab	2.4Ab	2.9Ab	2.1Ab	2.3Ab	2.5b
	Number of nematode larvae per 150 cm^3 soil, July 12					
Control	140Aa	156Aa	228Aa	136Aa	138Aa	160a
DBCP 12.1 EC, 10.1	50Ab	16Ab	52Ab	16Ab	60Ab	39b
	Number of southern stem rot infection loci per 15 m					
Control	16.3Aa	4.0Ba	9.5ABa	12.0ABa	12.5ABa	10.9a
DBCP 12.1 EC, 10.1	17.3Aa	5.8Ba	8.5ABa	5.8Ba	12.8ABa	10.0a

[1] Data followed by the same capital letter in rows or by the same lowercase letter in columns within each data set are not significantly ($\underline{P}$=0.05) different according to Duncan's multiple-range test.

Experiment 3

Peanut yields were increased by phenamiphos and aldicarb applied by one or two methods in PCNB-treated and untreated plots (table 5). Carbofuran and ethoprop did not increase yields. Yields differed among methods of application in only one instance. Average yields across PCNB-treated and untreated plots were increased by nematicides applied by all methods. The average yield increase attributed to nematicides was 465 kg/ha or 10.7%. Also, average yields for PCNB-treated plots were 392 kg/ha or 8.7% greater than those for untreated plots.

Phenamiphos and aldicarb applied by all methods in PCNB-treated and untreated plots and carbofuran applied by methods b and c in the PCNB-treated plots reduced root-knot indices (table 6). Average root-knot indices across PCNB-treated and untreated plots were reduced by nematicides applied by all methods. PCNB did not affect root-knot indices.

Phenamiphos applied by all methods in plots that received no PCNB and aldicarb applied by all methods in PCNB-treated plots reduced the numbers of root-knot nematode larvae (table 7). The average numbers of larvae across PCNB-treated and untreated plots were reduced by nematicides applied by all methods. PCNB did not affect the number of larvae.

Nematicides did not affect numbers of southern stem rot loci, but PCNB reduced the average number from 20 per 15.2 m of row in nontreated plots to 15 in treated plots (data not shown).

Yields were negatively correlated ($\underline{P}$=0.05) with root-knot index ($\underline{r}$=-0.53) and number of southern stem rot loci ($\underline{r}$=-0.36). Stepwise regression analysis indicated that 28% yield variation could be attributed to root-knot nematodes as estimated by root-knot indices and that 14% could be attributed to southern stem rot as estimated by the number of loci.

These data indicate that split applications of phenamiphos, aldicarb, carbofuran, and ethoprop were not superior to preplant applications applied at rates equivalent to the combined preplant-postplant rates. Nematicides and PCNB increased yield in an additive manner.

Table 5.--Influence of nematicides applied preplant and postplant and PCNB applied postplant on yield of peanuts, 2-year average, 1977-78 [1] (experiment 3)

	Nematicide rates (kg a.i./ha) and methods of application				
Nematicide	0.0 (control)	3.4 (a)	1.7+1.7 (b)	1.1+2.3 (c)	Average
			No PCNB		
Phenamiphos 15G	4,398ABa	4,664ABa	4,157Bb	5,121Aa	4,585a
Aldicarb 15G	4,183Ba	4,951Aa	5,184Aa	4,613ABb	4,733a
Carbofuran 15G	4,134Aa	3,913Ab	4,582Ab	4,267Ab	4,224a
Ethoprop 15G	4,079Aa	4,596Aa	4,596Ab	4,460Ab	4,433a
Average	4,199B	4,531AB	4,630A	4,615A	[2]4,494
			PCNB		
Phenamiphos 15G	4,306Ba	4,897ABab	5,272Aab	5,251Aa	4,931a
Aldicarb 15G	4,793Ba	5,094ABa	5,627Aa	5,162ABa	5,169a
Carbofuran 15G	4,112Ab	4,470Ab	4,644Ac	4,763Aa	4,497a
Ethoprop 15G	4,725Aa	4,983Aa	4,901Abc	5,176Aa	4,946a
Average	4,484B	4,861A	5,111A	5,088A	[2]4,886
Average (nematicides with PCNB treatments combined).	4,341B	4,696A	4,870A	4,852A	.....

[1]Data followed by the same capital letter in rows and the same lowercase letter in columns within no PCNB and PCNB data are not significantly ($\underline{P}$=0.05) different according to Duncan's multiple-range test.

[2]Significant ($\underline{P}$=0.01) response to PCNB.

Table 6.--Influence of nematicides applied preplant and PCNB applied postplant on root-knot indices of peanuts, 2-year average, 1977-78 [1] (experiment 3)

Nematicide	Nematicide rates (kg a.i./ha) and methods of application				
	0.0 (control)	3.4 (a)	1.7+1.7 (b)	1.1+2.3 (c)	Average
			No PCNB		
Phenamiphos 15G	3.8Aa	1.8Bb	1.9Bc	1.7Bc	2.3b
Aldicarb 15G	3.3Aa	2.0Bb	2.1Bbc	2.5Bb	2.5b
Carbofuran 15G	3.5Aa	3.0Aa	2.8Aa	3.2Aa	3.1a
Ethoprop 15G	3.2ABa	3.4Aa	2.6Bab	3.5Aa	3.2a
Average	3.4A	2.6BC	2.3C	2.7B	[2]2.8
			PCNB		
Phenamiphos 15G	4.0Aa	1.9Bb	1.6Bb	1.6Bc	2.3b
Aldicarb 15G	3.7Aa	2.0Bb	1.9Bb	2.2Bbc	2.5b
Carbofuran 15G	3.6Aa	3.2ABa	2.7Ba	2.8Bab	3.1a
Ethoprop 15G	3.6Aa	3.5Aa	2.9Aa	3.2Aa	3.3a
Average	3.7A	2.6B	2.3B	2.5B	[2]2.8
Average (nematicides and PCNB treatments combined).	3.6A	2.6B	2.3C	2.6B	....

[1] Data followed by the same capital letter in rows and the same lowercase letter in columns within no PCNB and PCNB data are not significantly (P=0.05) different according to Duncan's multiple-range test.

[2] There was no significant (P=0.05) response to PCNB.

Table 7.--Number of *Meloidogyne arenaria* larvae recovered per 150 cm^3 of soil from peanut plots treated preplant and postplant with nematicides and postplant with PCNB, 2-year average, 1977-78 [1] (experiment 3)

Nematicide	Nematicide rates (kg a.i./ha) and methods of application				
	0.0 (control)	3.4 (a)	1.7+1.7 (b)	1.1+2.3 (c)	Average
			No PCNB		
Phenamiphos 15G..................	687Aa	49Bb	45Bb	24Bb	201b
Aldicarb 15G.....................	377Ab	213Aab	109Ab	132Ab	208b
Carbofuran 15G...................	395Ab	347Aa	545Aa	653Aa	485a
Ethoprop 15G.....................	351Ab	315Aab	145Ab	176Ab	247b
Average.....................	452A	231B	211B	246B	[2]285
			PCNB		
Phenamiphos 15G..................	232Ab	41Ab	64Aa	63Ab	100b
Aldicarb 15G.....................	637Aa	144Bb	77Ba	132Bb	248b
Carbofuran 15G...................	554Aa	433Aa	221Aa	524Aa	433a
Ethoprop 15G.....................	253Ab	229Aab	273Aa	237Ab	248b
Average.....................	419A	212B	159B	239B	[2]257
Average (nematicides and PCNB treatments combined).	436A	222B	185B	243B	....

[1]Data followed by the same capital letter in rows and the same lowercase letter in columns within no PCNB and PCNB data are not significantly (P=0.05) different according to Duncan's multiple-range test.

[2]There was no significant (P=0.05) response to PCNB.

Experiment 4.

Peanut yields were greater in plots treated with phenamiphos at 2.8 kg a.i./ha at planting than in those receiving other preplant treatments (table 8). All postplant treatments applied to plots that did not receive a preplant treatment increased yields. Also, plots that received postplant ethylene dibromide at 35.8 kg a.i./ha and no preplant treatment yielded more peanuts than those that received ethylene dibromide at 17.9 kg a.i./ha. None of the postplant treatments applied to plots treated preplant with phenamiphos at 2.8 kg a.i./ha and ethylene dibromide at 35.8 kg a.i./ha increased yields over the preplant treatments. Conversely, phenamiphos at 1.1 and 2.8 kg a.i./ha applied postplant to plots preplant-treated with phenamiphos at 1.1 kg a.i./ha increased yields. Also, phenamiphos at 2.8 kg a.i./ha applied postplant to plots preplant-treated with ethylene dibromide at 17.9 kg a.i./ha increased yields. All postplant treatments except ethylene dibromide at 17.9 kg a.i./ha increased average yields, and phenamiphos treatments at 1.1 and 2.8 kg a.i./ha were superior to the ethylene dibromide treatments at 17.9 kg a.i./ha.

These data indicate that where moderate levels of *M. arenaria* are present, phenamiphos and ethylene dibromide applied postplant may reduce nematode populations and plant injury (tables 8,9) and increase peanut yields when control measures are not applied preplant to the crop or if applied and control is inadequate. The data also indicate that when adequate nematode control is obtained with preplant treatments, application of additional nematicides postplant is not beneficial.

Peanut yields were negatively correlated (P=0.01) with root-knot indices (r=-0.47) and numbers of southern stem rot loci (r=-0.33). The incidence of southern stem rot was <5.7 loci/15.2 m of row in all plots, and differences among preplant and postplant treatments were not significant (data not shown). However, the average number of loci per 15.2 m of row across postplant

Table 8.--Effects of nematicides applied preplant and postplant on peanut yields and root-knot indices, 2-year average, 1979-80[1] (experiment 4)

Preplant treatments and kg a.i./ha	Postplant treatments and kg a.i./ha					
	Control	Phenamiphos 15G 1.1	Phenamiphos 15G 2.8	Ethylene dibromide 12.1EC 17.9	Ethylene dibromide 12.1EC 35.8	Average
	Yield (kg/ha)					
Control	4,156Cb	4,835ABa	4,807ABa	4,443Ba	4,872Aa	4,622a
Phenamiphos 15G, 1.1	4,389Bb	4,882Aa	5,016Aa	4,660ABa	4,663ABa	4,723a
Phenamiphos 15G, 2.8	5,050Aa	5,046Aa	5,043Aa	4,810Aa	4,930Aa	4,976a
Ethylene dibromide 12.1 EC, 17.9	4,521Bb	4,910ABa	5,088Aa	4,866ABa	4,686Ba	4,814a
Ethylene dibromide 12.1 EC, 35.8	4,635Ab	4,816Aa	4,750Aa	4,742Aa	4,836Aa	4,756a
Average	4,551C	4,898A	4,941A	4,706BC	4,797AB	......
	Root-knot index					
Control	3.5Aa	2.6Ca	2.3Ca	3.1Ba	3.0Ba	2.9a
Phenamiphos 15G, 1.1	2.8Abc	2.2Ca	2.1Ca	2.6ABb	2.4BCb	2.4b
Phenamiphos 15G, 2.8	2.2Ac	2.2Aa	2.2Aa	2.4Ab	2.2Ab	2.3b
Ethylene dibromide 12.1 EC, 17.9	3.0Ab	2.4BCa	2.1Ca	2.6Bb	2.4BCb	2.5b
Ethylene dibromide 12.1 EC, 35.8	2.5Ac	2.2Aa	2.1Aa	2.4Ab	2.2Ab	2.3b
Average	2.8A	2.3C	2.2D	2.6B	2.5BC	....

[1] Data followed by the same capital letter in rows and the same lowercase letter in columns within yield and root-knot index data are not significantly (P=0.05) different according to Duncan's multiple-range test.

Table 9.--Effects of nematicides applied preplant and postplant to peanuts on population levels of *Meloidogyne arenaria* larvae, 2-year average, 1979-80[1] (experiment 4)

Preplant treatments and kg a.i./ha	Postplant treatments and kg a.i./ha					
	Control	Phenamiphos 15G		Ethylene dibromide 12.1EC		Average
		1.1	2.8	17.9	35.8	
	Number larvae 150 cm^3 soil					
Control	372ABa	309ABa	226Ba	494Aa	303ABa	341a
Phenamiphos 15G, 1.1	407Aa	240ABa	87Ba	337Aab	243ABa	263ab
Phenamiphos 15G, 2.8	227Aab	107Aa	179Aa	126Abc	132Aa	154bc
Ethylene dibromide 12.1 EC, 17.9.	318Aa	96Ba	134ABa	194ABa	155ABa	179bc
Ethylene dibromide 12.1 EC, 35.8.	70Ab	105Aa	63Aa	63Ac	103Aa	81c
Average	279A	171BC	138C	243AB	187BC	.....

[1]Data followed by the same capital letter in rows and the same lowercase letter in columns are not significantly (P=0.05) different according to Duncan's multiple-range test.

treatments was significantly greater in plots treated preplant with phenamiphos at 1.1 kg a.i./ha and ethylene dibromide at 35.8 kg a.i./ha than in control plots. Stepwise regression analysis indicated that 22% of yield variation could be attributed to root-knot nematodes as estimated by root-knot indices and that 12% could be attributed to southern stem rot as estimated by the number of loci.

CONCLUSIONS

Significant peanut-yield increases were obtained with nematicides applied preplant and postplant. In most instances where good nematode control was obtained with preplant treatments, additional yield increases were not obtained with postplant nematicide treatments. Split applications of nematicides to peanuts would not be advised except, perhaps, in fields with extremely high nematode infestation levels.

Yields were increased by phenamiphos + PCNB and ethoprop + PCNB when applied to plots that did not receive a preplant nematicide. Yields were also increased in some instances by PCNB, phenamiphos + PCNB, and ethoprop + PCNB when applied postplant to plots that received a preplant nematicide. A summary of the results of postplant nematicide and fungicide treatments applied to plots that received no preplant treatments is presented in table 10. Nematicides, fungicides, or nematicides plus fungicides increased peanut yields in every experiment. The greatest yield increases occurred for nematicide-plus-fungicide treatments.

These data indicate that yield increases were associated with suppression of nematodes, fungi, or both, according to the treatments; that southern stem rot loci were not reduced significantly by any nematicide treatment; and that nematode population levels were not reduced by any fungicide applied alone.

Results of these tests showed that where severe infestations of both *M. arenaria* and *S. rolfsii* occurred, applications of a nematicide + PCNB postplant increased yields over those associated with a nematicide applied preplant. This was most apparent where the preplant nematicide was ineffective. However, where the nematode and fungus infection was light, a preplant nematicide or a postplant nematicide plus PCNB treatment was adequate for maximum yield.

The studies demonstrated one of the major problems encountered in field-plot research. This is extreme variability of inoculum potentials of soilborne pathogens in the same area among years and among tests within years. This variability is normal with natural populations of soilborne pathogens and is frequently impossible to overcome by experimental design. Also, the method used to estimate southern stem rot (13) does not consider the severity of each disease locus and may not accurately estimate the damage caused by the disease.

All the nematicides tested, except DBCP, are labeled for use on peanuts. Although DBCP is an effective fumigant nematicide, its manufacture and use was recently restricted by the Environ-

Table 10.--Peanut-yield increase in plots that received a postplant nematicide, fungicide, or nematicide plus fungicide treatment, when compared to control

Treatment and kg a.i./ha	Actual and percentage of yield increase							
	Experiment 1		Experiment 2		Experiment 3		Experiment 4	
	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%
Ethoprop, 3.4	613	14.8	.....	....	...	...	...	....
Phenamiphos, 2.8	748	18.1	.....	....	...	...	[1]651	15.7
PCNB, 11.2	303	7.3	1,016	38.3	392	8.7	...	....
Ethoprop + PCNB, 3.4+11.12	1,041	25.1	1,674	63.1	...	...	...	....
Phenamiphos + PCNB, 2.8+11.2	1,341	32.4	.....	....	...	...	...	....
Carboxin, 1.2			252	9.5	...	...	...	....
Ethoprop + carboxin, 3.4+1.2			707	26.7	...	...	...	....
Ethylene dibromide, 35.8							[1]716	17.2

[1]Yield increases in plots treated postplant with 2.8 kg/ha of phenamiphos or 35.8 kg/ha of ethylene dibromide.

mental Protection Agency (2). Even though DBCP cannot be used on peanuts, it serves as a standard of performance for other nematicides and nematicide-fungicide interactions. Ethylene dibromide, which was also included in these studies and is approved for use on peanuts, is closely related to DBCP chemically and performs similarly.

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